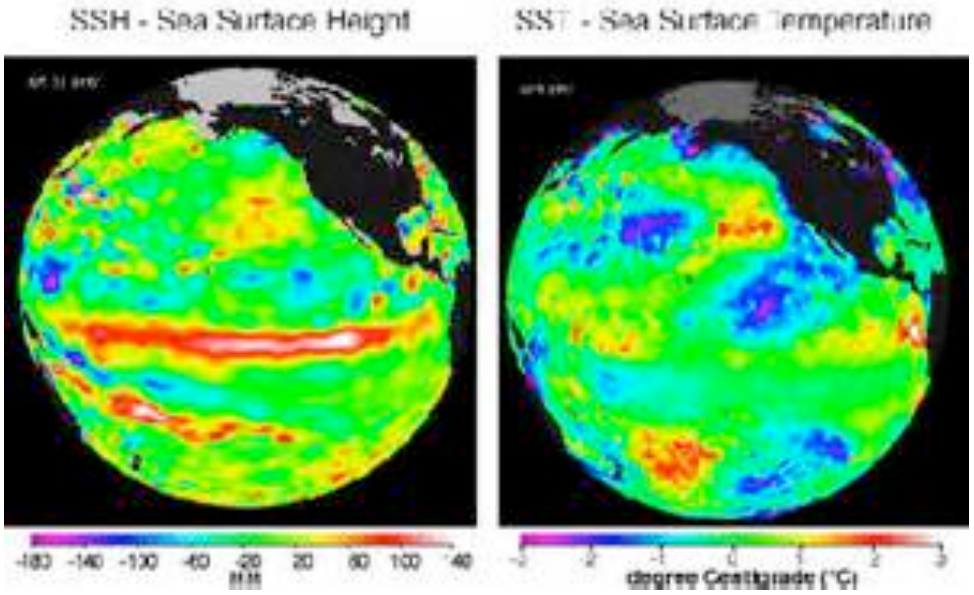
Monitoring Climate Variability



Objective

To discuss i) climate variability associated with ocean-atmosphere interactions, ii) standardized climate indices, and iii) access to climate variability information

Outline

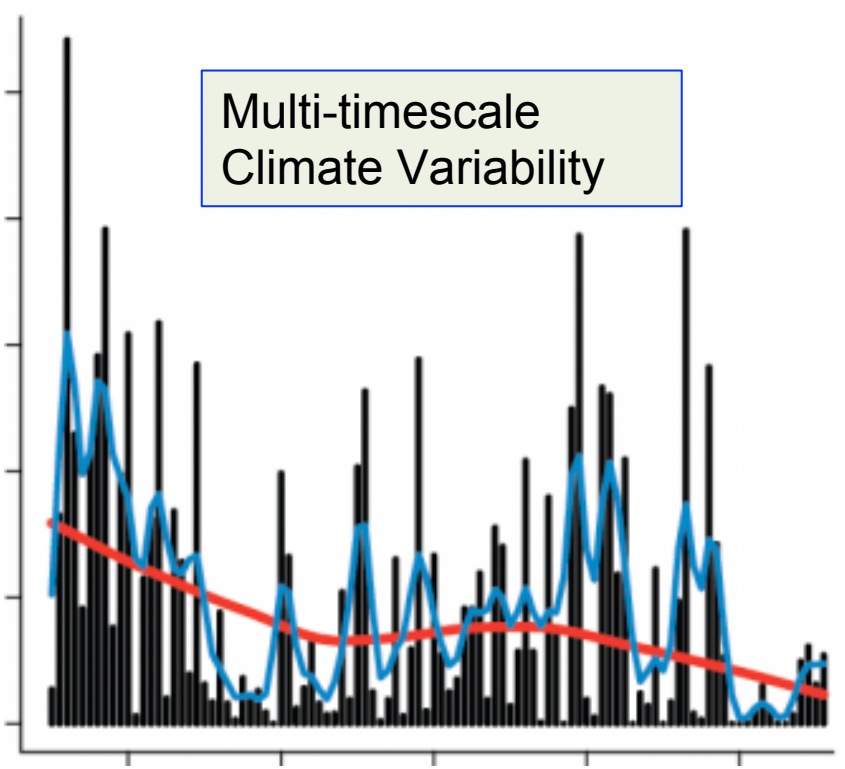
- Climate Variability
- El Nino and La Nina / Southern Oscillation
- *NOAA Climate Variability Indices and Access (With Live Demo)*
- *International Research Institute (IRI) Climate Data Portal (With Live Demo)*

Climate Variability

Review: Climate Variability

- Climate is defined as the statistical mean of weather or 'instantaneous' conditions
- Climate Variability is generally observed as 'large scale spatial patterns' changing with 'low temporal frequency' (persisting anomalies – or departure from time-mean conditions)
- At any location daily weather conditions and weekly to intraseasonal (40-50 days) variations in circulations and hydrologic conditions result due to contributions from:

  - *Climate Change*
  - *Climate variability on various time-scale*



Climate Variability

Climate Variability can be due to any one or a combination of these factors:

- Sea Surface Temperature Variability
- Atmospheric Variability
- Atmosphere Tele-connection

It is important to know the climate conditions (factors above) to understand and predict how they affect regional and local conditions on daily to seasonal time scales

Major Climate Variability Phenomena Affecting South America on inter-annual to Decadal Scales

El Niño – Southern Oscillation (ENSO)

Focus of this training

Pacific Decadal Oscillation (PDO)

Antarctic Oscillation (AAO)

Tropical Atlantic Sea Surface Temperature

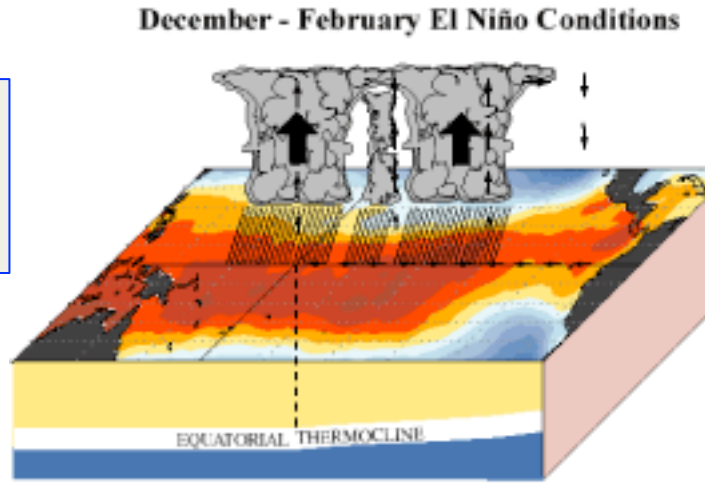
Reference: Past Climate Variability in South America and Surrounding Regions From the Last Glacial Maximum to the Holocene
Editors: Vimeux, Francoise, Sylvestre, Florence, Khodri, Myriam (Eds.)
http://www.springer.com/us/book/9789048126712

El Niño, La Niña, and Southern Oscillation (ENSO)

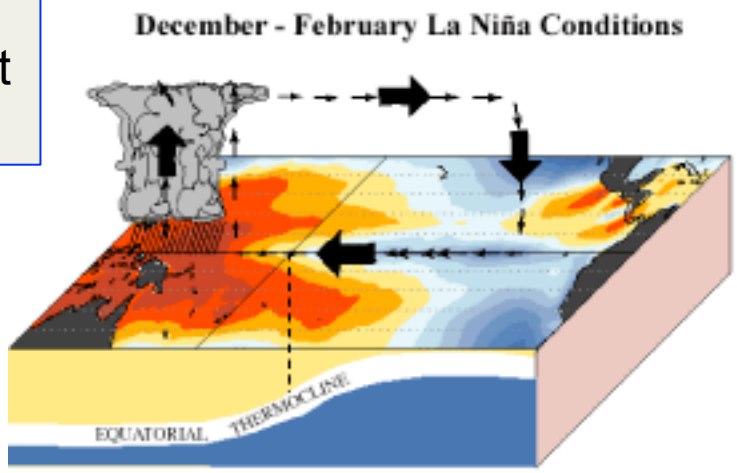
El Niño, La Niña and the Southern Oscillation

- "ENSO" or the El Niño/Southern Oscillation, is the cycle of warming (El Niño) and cooling (La Niña) events that take place **over roughly 2-7 year intervals** over the equatorial Pacific Ocean and the atmosphere above it.
- SO: is defined as sea level pressure change between Tahiti and Darwin
- This year-to-year or multi-year variability in oceanic and atmospheric conditions has far-reaching impacts, called "teleconnections", on seasonal precipitation and temperature patterns in many areas of the globe.

Weak east to west circulation



Intensified east to west circulation



NOAA Climate Variability Indices and Access

Climate Variability Indices

NOAA Provides Climate Variability Indices
http://www.esrl.noaa.gov/psd/data/climateindices/list/

Climate conditions are represented by specific indices derived from sea Surface temperature (e.g. El Nino and La Nina), sea level pressure (e.g. Southern Oscillation), and other variables (such as precipitation, momentum)

ENSO Indices

http://www.esrl.noaa.gov/psd/data/climateindices/list/

Indices	
Niño 3	Eastern Tropical Pacific SSTA (5°N-5°S,150°W-90°W)
Niño 1+2 (90°W-80°W)	*Extreme Eastern Tropical Pacific SSTA* (0°-10°S,
Niño 4	*Central Tropical Pacific SSTA* (5°N-5°S) (160°E-150°W)
Niño 3.4 (170°-120°W)	*East Central Tropical Pacific SSTA* (5°N-5°S)
SOI Difference	*Southern Oscillation Index* (Sea Level Pressure
	Tahiti-Darwin)

SSTA is Sea Surface Temperature Anomalies

(MEI) (Bimonthly Time

NOAA Climate Indices

http://www.esrl.noaa.gov/psd/data/climateindices/list/

NOAA provides:

- Monthly values of the Climate Indices from 1948 to present
- Monthly and seasonal time series plots of user-selected Climate Indices for selected years

Climate Indices

Teleconnections:

PNA | WP | NAO | EP/NP | EA/WR | NAO (Jones) | NP | NOI | PDO

Atmosphere:

QBO | Global Angular Momentum | SOI | AAO | AO | MJO

Precipitation:

Indian Monsoon | Sahel | SW Monsoon | ESPI | Brazil

ENSO:

MEI | Nino 1+2 | Nino 3 | Nino 3.4 | Nino 4 | BEST | Tropical Pacific EOF

SST:Pacific

ONI | Nino 1+2 | Nino 3 | Nino 3.4 | Nino 4 | TNI | WHWP | Pacific Warm Pool | Tropical Pacific EOF

SST:Atlantic

MDR | MDRMTROP | TNA | TSA | Atlantic Tripole | WHWP | Atlantic Multi-decadal Oscillation | Atlantic Meridional Mode | North Tropical Atlantic Index (NTA) | Caribbean Index (CAR)

Other:

Global Mean Lan/Ocean Temperature | Solar Flux | Trend | Hurricane Activity

NOAA Climate Indices

http://www.esrl.noaa.gov/psd/data/climateindices/

Plotting and Analysis of Monthly Climate Indices

Selected Longer (18xx) timeseries

Directions and comments

Teleconnections:

PNA | *WP* | *NAO* | *EP/NP* | *EA/WR* | *NAO (Jones)* | *NP* | *NOI* | *PDO*

Atmosphere:

QBO | *Global Angular Momentum* | *SOI* | *AAO* | *AO* | *MJO*

Precipitation:

Indian Monsoon | *Sahel* | *SW Monsoon* | *ESPI* | *Brazil*

ENSO:

MEI | *Nino 1+2* | *Nino 3* | *Nino 3.4* | *Nino 4* | *BEST* | *Tropical Pacific EOF*

SST:Pacific

ONI | *Nino 1+2* | *Nino 3* | *Nino 3.4* | *Nino 4* | *TNI* | *WHWP* | *Pacific Warm Pool* | *Tropical Pacific EOF*

Purpose: Plot, analyze and compare different monthly mean climate time series.

Anomalies are now available. Climatology is entire time period of time series. I am actively working on improvements and additions. Suggestions are welcome.

Time Series 1? PNA (Pacific North American Index) **If custom** what is filename?
If custom what is time series title?

Time Series 2? None **If custom** what is filename?
If custom, what is time series title

Year range? (1948 to present): to
Action?

- (•) Plot time series
  - ***Optional* Set y range:** to | Type of Plot: (•) Line ( ) Boxes
  - ***Optional* Apply Running Mean to monthly values:**: months (use odd number)
- ( ) Correlate two time series
  - **Lag of 1st time series?** Positive lag values indicate 1st time series leads 2nd; negative lag values means 1st lags second.
  - **Correlate using?** (•) All months or seasons in time-series (1 value) ( ) Each months or season calculated separately
- ( ) Plot autocorrelation function
- ( ) Plot Cross correlation function

For all actions:
Time Averaging? (•) Monthly ( ) Seasonal Average First Month of season: Jan Second: Dec
Type of data? (•) Mean ( ) Anomaly

Live Demo of
NOAA Climate Indices Portal

International Research Institute (IRI) Climate Data Portal

Courtesy:
Pietro Ceccato
The International Research Institute for Climate and Society

IRI Climate Map Room

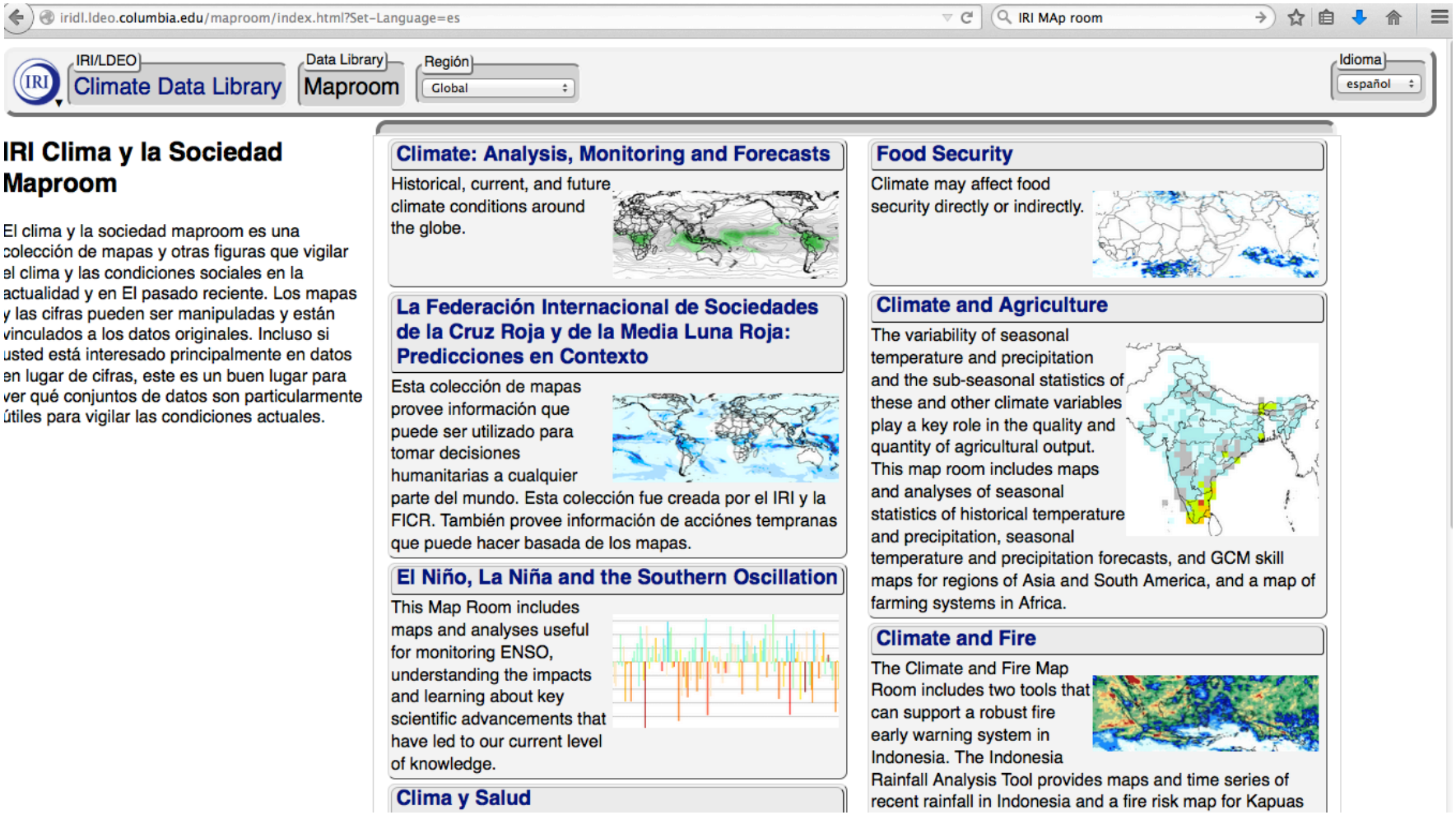
http://iridl.ldeo.columbia.edu/maproom/index.html?Set-Language=es

- Access to Current Climate Maps and Forecast: Global and Regional
- Regional Information on Health, Fire, Food Security
- Access to Climate Data Library (More Advanced Training with Programming Required)

IRI Climate Map Room

http://iridl.ldeo.columbia.edu/maproom/index.html?Set-Language=es

Available in Multiple languages



IRI Climate Data Library

http://iridl.ldeo.columbia.edu/

Also Available in Multiple languages

The IRI Data Library is a…

- Data repository
  - >400 datasets covering all aspects of climate-related characteristics
- Data visualization tool
  - Time series, maps, cross-sections
- Data analysis tool
  - Arithmetic operations → EOF analysis
- Data download resource
  - Free access to text, binary, GIS-compatible, etc. data files

http://
iridl.ldeo.columbia.edu

Structure of Datasets

Primary Organization
-Dataset
-Dataset
-Variables
-Dataset
-Variables
-Dataset
-
Variables

-Primary Organization
.
.
.
.

Example

-NASA
-ERBE (Earth Radiation Budget Experiment)
-Datasets by instrument
-Variables
-GES-DAAC (Distributed Active Archive Center)
-
-GISS
-LeGrande_Schmidt2006 (authors)
-GPCP (Global Precip Climatology Project)
-Datasets by version
-Datasets by instrument
-Variables
.
.
.
.

iridl.ldeo.columbia.edu

IRI/LDEO Climate Data Library

Google™ Custom Search

Language: english

IRI/LDEO Climate Data Library

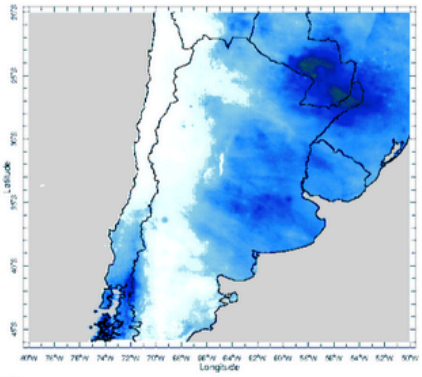
The IRI Data Library is a powerful and freely accessible online data repository and analysis tool that allows a user to view, analyze, and download hundreds of terabytes of climate-related data through a standard web browser.

It is a powerful tool that offers the following capabilities at no cost to the user:

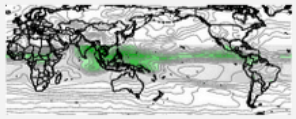
- access any number of datasets;
- create analyses of data ranging from simple averaging to more advanced EOF analyses using the Ingrid Data Analysis Language;
- monitor present climate conditions with maps and analyses in the Maproom;
- create visual representations of data, including animations;
- download data in a variety of commonly-used formats, including GIS-compatible formats.

Latest from What's New

UCSB CHIRPS Version 1.8 Precipitation Analyses



IRI Climate and Society Map Room



The climate and society maproom is a collection of maps and other figures that monitor climate and societal conditions at present and in the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.

What's New

Data Library announcements about new datasets and capabilities are available on our tumblr blog

Data by Source

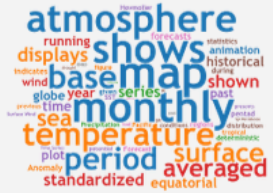
Datasets organized by source, i.e. creator and/or provider.

Data by Category

Selected Datasets for particular topics

Dataset and Map Room Browser

Find datasets and maps organized by many characteristics and keywords



Navigating Through the IRI Data Library: A Tutorial

The goal of this tutorial is to introduce you to the structure of the Data Library and the many ways to navigate through it.

Statistical Techniques in the Data Library: A Tutorial

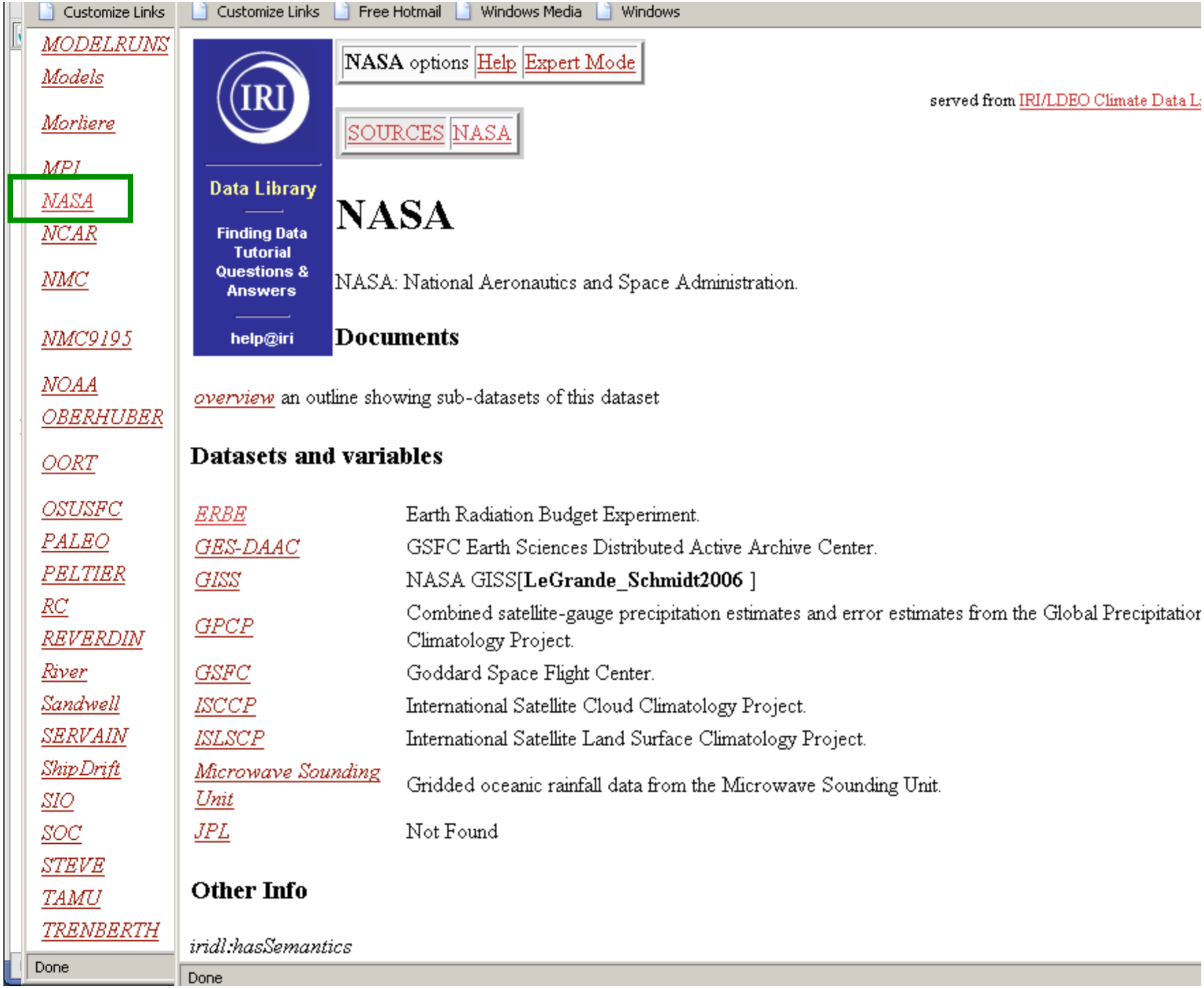
Statistical techniques are essential tools for analyzing large datasets; this statistics tutorial thus covers essential skills for many data library users.

Function Index

Index for functions that can be used to analyze data within the Data Library.

Help Resources

The Help Resources include basic and statistics tutorials, function documentation, and other resources to help you get the maximum utility out of the Data Library


Customize Links
Customize Links
Free Hotmail
Windows Media
Windows
MODELRUNS
Models
Morliere
MPI
NASA
NCAR
NMC
NMC9195
NOAA
OBERHUBER
OORT
OSUSFC
PALEO
PELTIER
RC
REVERDIN
River
Sandwell
SERVAIN
ShipDrift
SIO
SOC
STEVE
TAMU
TRENBERTH
Done
IRI
Data Library
Finding Data
Tutorial
Questions & Answers
help@iri
NASA options
Help
Expert Mode
served from IRI/LDEO Climate Data L
SOURCES
NASA
NASA
NASA: National Aeronautics and Space Administration.
Documents
overview an outline showing sub-datasets of this dataset
Datasets and variables
ERBE
Earth Radiation Budget Experiment.
GES-DAAC
GSFC Earth Sciences Distributed Active Archive Center.
GISS
NASA GISS[LeGrande_Schmidt2006]
GPCP
Combined satellite-gauge precipitation estimates and error estimates from the Global Precipitatior Climatology Project.
GSFC
Goddard Space Flight Center.
ISCCP
International Satellite Cloud Climatology Project.
ISLSCP
International Satellite Land Surface Climatology Project.
Microwave Sounding Unit
Gridded oceanic rainfall data from the Microwave Sounding Unit.
JPL
Not Found
Other Info
iridl:hasSemantics
Done

iridl.ldeo.columbia.edu

IRI/LDEO Climate Data Library

Google™ Custom Search

Language: english

IRI/LDEO Climate Data Library

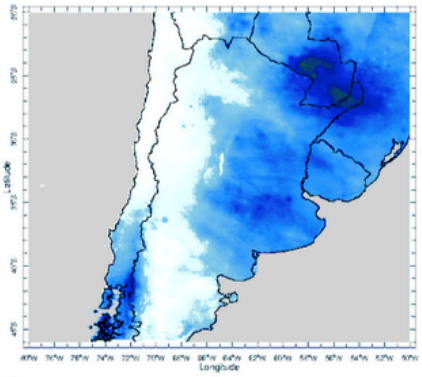
The IRI Data Library is a powerful and freely accessible online data repository and analysis tool that allows a user to view, analyze, and download hundreds of terabytes of climate-related data through a standard web browser.

It is a powerful tool that offers the following capabilities at no cost to the user:

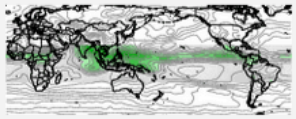
- access any number of datasets;
- create analyses of data ranging from simple averaging to more advanced EOF analyses using the Ingrid Data Analysis Language;
- monitor present climate conditions with maps and analyses in the Maproom;
- create visual representations of data, including animations;
- download data in a variety of commonly-used formats, including GIS-compatible formats.

Latest from What's New

UCSB CHIRPS Version 1.8 Precipitation Analyses



IRI Climate and Society Map Room



The climate and society maproom is a collection of maps and other figures that monitor climate and societal conditions at present and in the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.

What's New

Data Library announcements about new datasets and capabilities are available on our tumblr blog

Data by Source

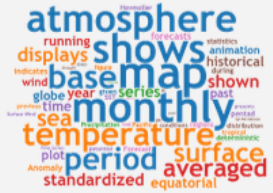
Datasets organized by source, i.e. creator and/or provider.

Data by Category

Selected Datasets for particular topics

Dataset and Map Room Browser

Find datasets and maps organized by many characteristics and keywords



Navigating Through the IRI Data Library: A Tutorial

The goal of this tutorial is to introduce you to the structure of the Data Library and the many ways to navigate through it.

Statistical Techniques in the Data Library: A Tutorial

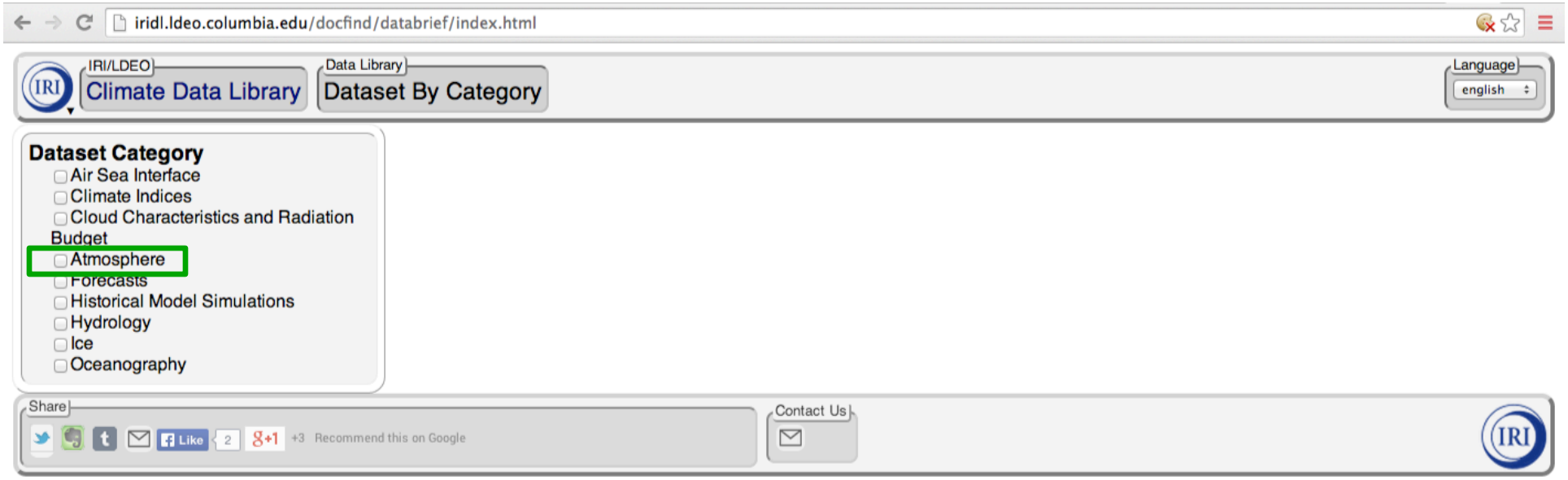
Statistical techniques are essential tools for analyzing large datasets; this statistics tutorial thus covers essential skills for many data library users.

Function Index

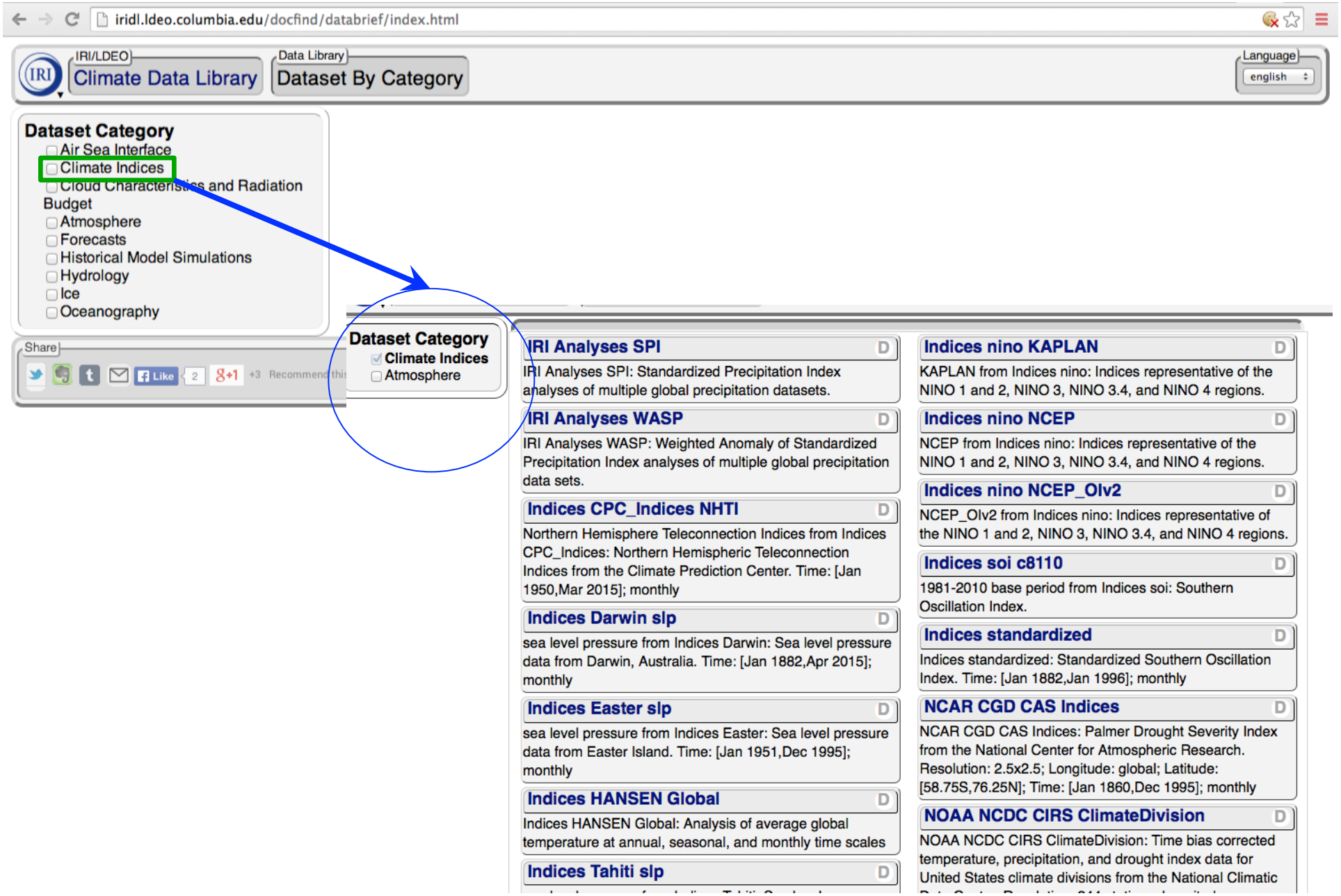
Index for functions that can be used to analyze data within the Data Library.

Help Resources

The Help Resources include basic and statistics tutorials, function documentation, and other resources to help you get the maximum utility out of the Data Library

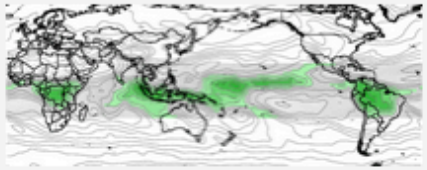


- Air-Sea Interface
- Atmosphere
- Climate Indices
- Cloud Characteristics and Radiation Budget
- Fisheries
- Forecasts
- Historical Model Simulations
- Hydrology
- Ice
- Oceanography
- Topographic and Land Characteristics


iridl.ldeo.columbia.edu/docfind/databrief/index.html
IRI/LDEO
Climate Data Library
Data Library
Dataset By Category
Language
english
Dataset Category
Air Sea Interface
Climate Indices
Cloud Characteristics and Radiation Budget
Atmosphere
Forecasts
Historical Model Simulations
Hydrology
Ice
Oceanography
Share
Like
Dataset Category
Climate Indices
Atmosphere
IRI Analyses SPI
IRI Analyses SPI: Standardized Precipitation Index analyses of multiple global precipitation datasets.
IRI Analyses WASP
IRI Analyses WASP: Weighted Anomaly of Standardized Precipitation Index analyses of multiple global precipitation data sets.
Indices CPC_Indices NHTI
Northern Hemisphere Teleconnection Indices from Indices CPC_Indices: Northern Hemispheric Teleconnection Indices from the Climate Prediction Center. Time: [Jan 1950,Mar 2015]; monthly
Indices Darwin slp
sea level pressure from Indices Darwin: Sea level pressure data from Darwin, Australia. Time: [Jan 1882,Apr 2015]; monthly
Indices Easter slp
sea level pressure from Indices Easter: Sea level pressure data from Easter Island. Time: [Jan 1951,Dec 1995]; monthly
Indices HANSEN Global
Indices HANSEN Global: Analysis of average global temperature at annual, seasonal, and monthly time scales
Indices Tahiti slp
Indices nino KAPLAN
KAPLAN from Indices nino: Indices representative of the NINO 1 and 2, NINO 3, NINO 3.4, and NINO 4 regions.
Indices nino NCEP
NCEP from Indices nino: Indices representative of the NINO 1 and 2, NINO 3, NINO 3.4, and NINO 4 regions.
Indices nino NCEP_OIv2
NCEP_OIv2 from Indices nino: Indices representative of the NINO 1 and 2, NINO 3, NINO 3.4, and NINO 4 regions.
Indices soi c8110
1981-2010 base period from Indices soi: Southern Oscillation Index.
Indices standardized
Indices standardized: Standardized Southern Oscillation Index. Time: [Jan 1882,Jan 1996]; monthly
NCAR CGD CAS Indices
NCAR CGD CAS Indices: Palmer Drought Severity Index from the National Center for Atmospheric Research. Resolution: 2.5x2.5; Longitude: global; Latitude: [58.75S,76.25N]; Time: [Jan 1860,Dec 1995]; monthly
NOAA NCDC CIRS ClimateDivision
NOAA NCDC CIRS ClimateDivision: Time bias corrected temperature, precipitation, and drought index data for United States climate divisions from the National Climatic

IRI Climate and Society Map Room

The climate and society maproom is a collection of maps and other figures that monitor climate and societal conditions at present and in the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.



Data by Source

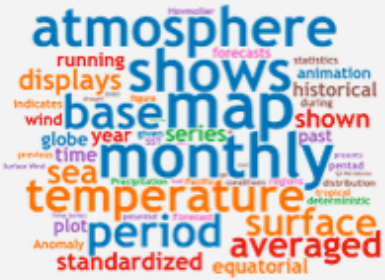
Datasets organized by source, i.e. creator and/or provider.

Data By Category

Selected Datasets for particular topics

Dataset and Map Room Browser

Find datasets and maps organized by many characteristics and keywords



Navigating Through the IRI Data Library: A Tutorial

The goal of this tutorial is to introduce you to the structure of the Data Library and the many ways to navigate through it.

Statistical Techniques in the Data Library: A Tutorial

Statistical techniques are essential tools for analyzing large datasets; this statistics tutorial thus covers essential skills for many data library users.

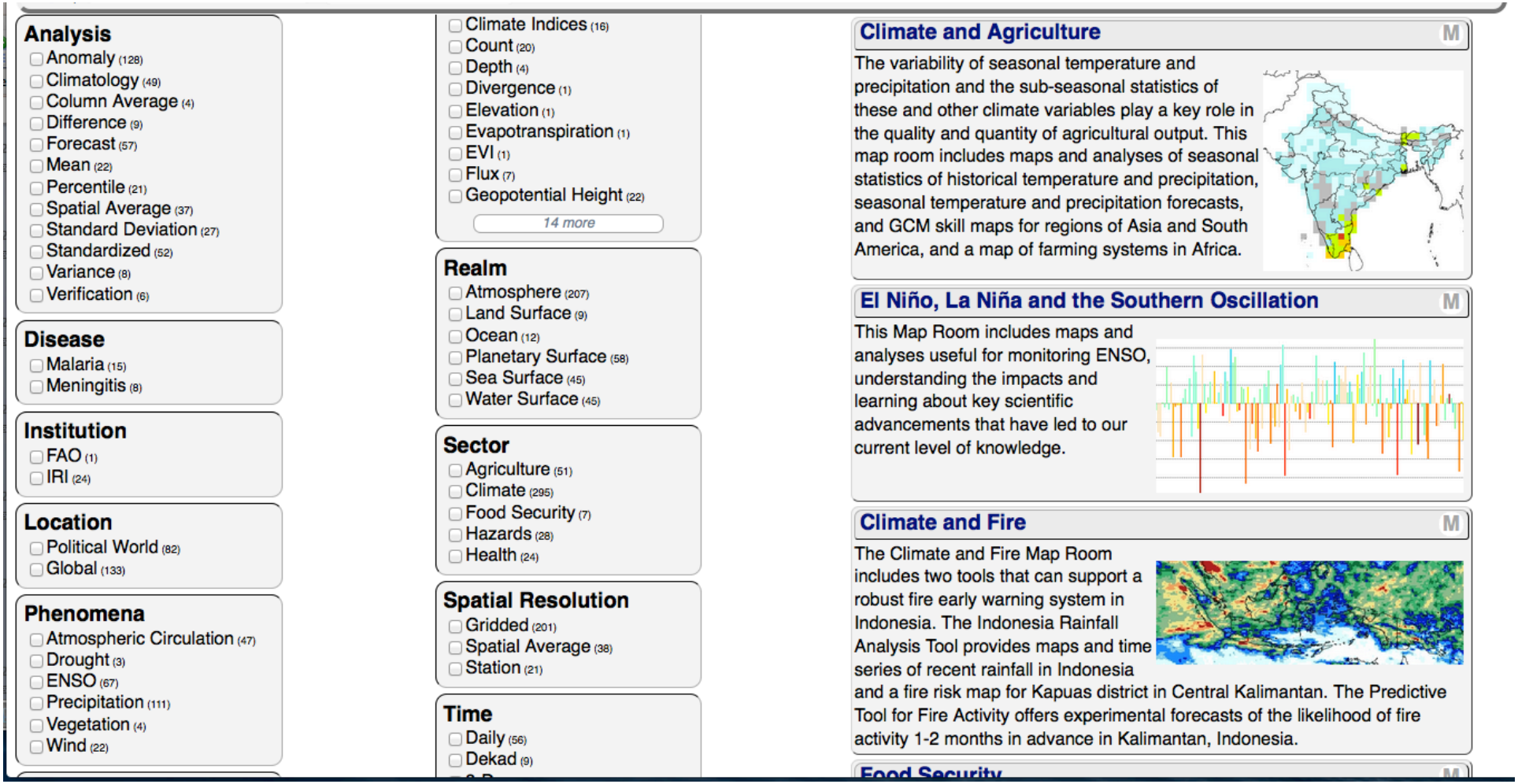
Function Index

Index for functions that can be used to analyze data within the Data Library.

Help Resources

The Help Resources include basic and statistics tutorials, function documentation, and other resources to help you get the maximum utility out of the Data Library

Options for Map Room Visualization



Options for Data Download Formats

Example: SST Anomaly

NOAA NCEP EMC CMB GLOBAL Reyn_SmithOIv2 monthly ssta Data Files

This dataset has bytes (1.0342080E08 98.629761MB) of data in it, which should give you a rough idea of the size of any file that you ask for.

Download Data To Specific Software

ingrid	The Postscript-based software on which the Data Library is built.
CPT	Climate Predictability Tool More information
ferret	Interactive computer visualization and analysis software. More information
GrADS	Grid Analysis and Display System More information
matlab	Data analysis and visualization software. More information
NCL	NCAR Command Language More information
WinDisp	A public domain software package for the display and analysis of satellite images, maps and associated databases, with an emphasis on early warning for food security. More information

Other Available File Formats

Full Information Formats These files contain all of the available metadata.	
OPeNDAP	A system which downloads data directly to software, such as matlab, Ferret, GrADS, etc. Specific instructions are available in the table above. Note: OPeNDAP was formerly known as DODS (Distributed Oceanographic Data System). More Information
netCDF (network Common Data Form)	A commonly supported self-describing data format. More Information

Partial Information Formats These files contain only some of the available metadata.	
Columnar Table	A table with separate columns of numbers for each independent variable (i.e., grids) and for the data. This is an inefficient format, so you would have gotten a HUGE file for dataset of this size. This file will be approximately 413683200 bytes, with 4 columns of 25855200 numbers.
2-Dimensional Tab-Separated Tables	Tab-separated-values (tsv) file with information about the independent variables (i.e., grids). The list to the left allows you to specify the format of the table.

Live Demo of IRI Climate Data Library and Map Room

Next:

Hands-on Activity to

1) Learn to Access Climatology and ENSO Variability Information using IRI Map Room